EUROPEAN PATENT OFFICE

Patent Abstracts of Japan

PUBLICATION NUMBER : 61131428
PUBLICATION DATE : 19-06-86

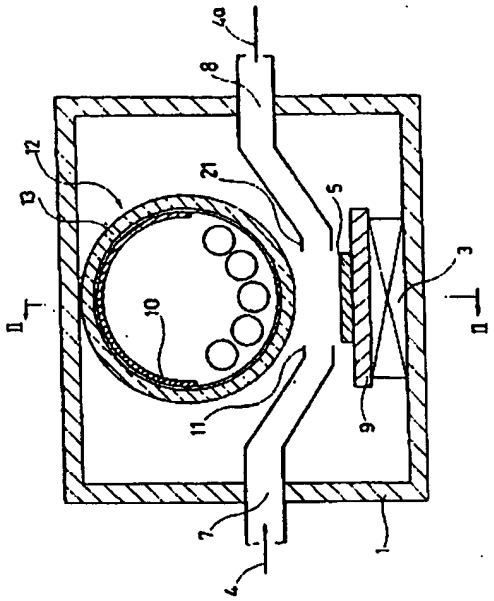
APPLICATION DATE : 29-11-84
APPLICATION NUMBER : 59253455

APPLICANT : MITSUBISHI ELECTRIC CORP;

INVENTOR : ODA MASAO;

INT.CL. : H01L 21/205 H01L 21/263 H01L 21/31

TITLE : SEMICONDUCTOR MANUFACTURING EQUIPMENT



ABSTRACT : PURPOSE: To contrive to improve the efficiency of work by a method wherein a light source that plural linear lamps are incorporated in the interior of the quartz glass tube is provided in the reaction chamber and a reflecting mirror which also serves as a shutter is provided in the interior of the quartz glass tube.

CONSTITUTION: A light source that plural linear lamps are arranged in the interior of a cylindrical quartz glass tube 13 is used as this light source. By providing this light source 12 in a reaction chamber 1, the light source 12 is made to get near a substrate 5 to an arbitrary distance and the illuminance of light on the substrate 5 can be raised. Moreover, after the formation of a thin film on the substrate 5, the light from the light source 12 is shielded in such a way as to be able to shield by lowing a shutter 10. Accordingly, the reaction gas remaining is decomposed and the reaction product can be prevented from depositing by adhesion on the surface of the quartz glass tube 13 and the substrate 5 can be replaced leaving the linear lamps intact being lighted. As a result, the improvement of the efficiency of work can be contrived.

⑲日本国特許庁(JP)　⑪特許出願公開

⑫公開特許公報(A)　昭61－131428

⑤1Int.Cl.⁴	識別記号	庁内整理番号	㊸公開　昭和61年(1986)6月19日
H 01 L 21/205 21/263 21/31		7739－5F 6708－5F	審査請求　未請求　発明の数 1　(全5頁)

㊹発明の名称　半導体製造装置

㉑特　願　昭59－253455
㉒出　願　昭59(1984)11月29日

㉒発明者　小林　利行　尼崎市塚口本町8丁目1番1号　三菱電機株式会社生産技術研究所内
㉒発明者　大友　芳視　尼崎市塚口本町8丁目1番1号　三菱電機株式会社生産技術研究所内
㉒発明者　木之下　義美　尼崎市塚口本町8丁目1番1号　三菱電機株式会社生産技術研究所内
㉒発明者　織田　昌雄　尼崎市塚口本町8丁目1番1号　三菱電機株式会社生産技術研究所内
㉑出願人　三菱電機株式会社　東京都千代田区丸の内2丁目2番3号
㉔代理人　弁理士　早瀬　憲一

明　細　書

1．発明の名称

半導体製造装置

2．特許請求の範囲

(1)　反応室内の反応ガスに光源からの光を投射して光化学反応を生じさせ該反応ガス中に置かれた基板上に薄膜を形成させる半導体製造装置において、上記光源が反応室内に設けられた石英ガラス管内に複数の線状ランプが配設されてなるものであり、上記薄膜の形成時に非基板側に位置して光を反応ガスに反射し、上記薄膜の非形成時に基板側に位置して反応ガスへの光を遮蔽するための反射遮蔽部材が上記石英ガラス管壁に沿って移動可能に設けられていることを特徴とする半導体製造装置。

3．発明の詳細な説明

(産業上の利用分野)

この発明は、光化学的に反応ガスを分解して薄膜を基板上に形成させる方法（photo chemical vapour deposition：以下光励起ＣＶＤ法と称す）を用いて薄膜を形成する半導体製造装置に関するものである。

(従来の技術)

ＣＶＤ法は集積回路装置における薄膜形成等において重要な技術であるが、従来のＣＶＤ法は、主として反応ガスを加熱して化学反応を起こさせるようにしており、このため反応温度が高温となり、これにより形成される薄膜はダメージを受け易いものである。

そこで最近、低温ＣＶＤ技術として光励起ＣＶＤ法が注目されている。この光励起ＣＶＤ法は、ＣＶＤのエネルギー源として光を用いるものであり、これによれば、従来の熱励起ＣＶＤ法、プラズマＣＶＤ法等に比較して反応温度を低温にでき、薄膜へのダメージも少なくすることができる。

また、一般的に光励起ＣＶＤ法では、光の強度が薄膜の形成速度に大きな影響を与えることが知られており、基板温度、反応ガスの組成比、圧力を一定に保った条件下では、薄膜の形成速度は光の照射強度に比例して速くなることが知られてい

る。

第3図はこのような光励起CVD法による従来の薄膜形成装置の基本的な構成を示し、図において、1は膜形成時にその中が高真空状態に減圧される反応室、2は線状ランプからなる光源、3は基板加熱用ヒータ、4はシラン等の反応ガス、5は薄膜が形成される基板、6は光透過材からなる光入射窓、7は反応ガス供給口、8は反応後のガス4aを排出するためのガス排出口、9は基板5を載せる固定台である。

なお、反応室1内は一般的に高真空状態に減圧され、反応室1の壁，光透過材からなる光入射窓6も当然この圧力に耐えうる構造，板厚により構成されている。

この装置では、反応ガス4が供給口7から反応室1に導入されると、該反応ガス4は入射窓6から投射された光線により励起分解される。そしてこれにより生じた反応生成物がヒータ3によって低温加熱された基板5上に堆積し、該基板5上に薄膜が形成される。反応後のガス4aは排出口8から排出される。

〔発明が解決しようとする問題点〕

この従来の半導体製造装置では以上のように反応室1に光の入射窓6を設け、反応室1外に設けられた光源2から光を投射しているが、基板5上への薄膜の形成速度を速めるためには基板5上の光の照度を強くする必要があり、このためにはより出力の大きな光源を用いるか、基板5と光源2の距離を縮め、基板5上の照度を強くする必要がある。ところが、長寿命で出力の大きい実用的な光源を求めることは現在では困難であり、また従来の構造のまま基板5と光源2の間の距離を縮めることもこれらの間に光透過材からなる光入射窓6を、高真空の圧力に耐えられる構造で反応室1に取り付けねばならないことからはなはだ困難であった。

また、紫外線ランプ2を点灯していると、反応室1の内壁、あるいは光入射窓6に反応生成物が堆積してしまうという問題があり、基板5に薄膜形成が完了した場合、紫外線ランプ2をOFFさせねばならず、新たにONさせるとその照射強度が安定するまで時間がかかる等、作業能率が悪いという問題点があった。

この発明は、このような問題点を解消するためになされたもので、基板上の光の照度を高めることができ、さらには作業の効率化を図ることができる半導体製造装置を得ることを目的とするものである。

〔問題点を解決するための手段〕

この発明に係る半導体製造装置は、反応室内の石英ガラス管内に線状ランプを複数個配設してなるものを光源として用い、かつ基板5側（光と反射しあいは）への光を遮蔽するための反射鏡兼用シャッタを上記石英ガラス管壁に沿って移動可能に設けたものである。

〔作用〕

この発明においては、石英ガラス管からなる光源を反応室内に設け、かつ該石英ガラス管に反射鏡兼用シャッタを設けたから、基板上の光の照度が非常に高まり、薄膜は速く形成される。また薄膜形成完了後は、シャッタにより光源からの光を遮蔽するようにしたから、線状ランプを点灯したままで基板の入れ替えができ、作業の効率化が図れる。

〔実施例〕

以下、本発明の実施例を図について説明する。

第1図は本発明の一実施例による半導体製造装置の断面図、第2図は第1図のII－II線断面図である。両図において、1は反応室、13は該反応室1内に設けられた円筒形石英ガラス管、12は該石英ガラス管13の内壁に沿って複数の線状ランプが配設されてなる光源、10は上記石英ガラス管13の内壁に沿って移動可能に設けられた反射鏡兼用回転式シャッタであり、これは薄膜形成時に非基板側、即ち上記内壁上部に位置して線状ランプからの紫外線を反射させる反射鏡として機能し、非形成時に基板側、即ち下部に位置して上記反応ガス4への光を遮蔽するための反射遮蔽部材である。この部材はアルミニウム板を用いて鏡面仕上げされている。14は該シャッタ10を駆動するシャッタ駆動機構、3は基板加熱用ヒータ、

4は反応ガス、5は基板、7は反応ガス供給口、8は反応後のガス4aを排出するためのガス排出口、9は基板5を載置する台、11は円筒形石英ガラス管13の曲面側の一端に設けられた反応ガス供給ノズル、21は該供給ノズル11とともに円筒形石英ガラス管13を挟むよう該ノズル11と反対側に設けられたガス排出ノズルである。

次に作用効果について説明する。

本装置においては、反応ガス4は供給口7から反応室1内に供給され、一方光源12である円筒形石英ガラス管13から光が投射されて該反応ガス4が光化学反応を生じ、ヒータ3によって加熱されている基板5上に薄膜が形成される。なおこの際は、上記石英ガラス管13内のシャッタ10は上方に位置している。

そして本装置では、円筒形石英ガラス管13内に複数の線状ランプを配設したものを光源として用い、該光源12を反応室1内に設けたので、該光源12を任意の距離まで基板5に近づけて基板5上の光の照度を高めることができ、しかも上記4を短い距離だけ流せばよいため、反応室1内の不必要な部分に反応ガス4が流れるのを防止できる。又、反応ガスを短い距離を効率よく流すことができるため、反応ガスの濃度を均一に、しかも反応ガスの光化学反応の速度に合わせ十分な量の反応ガスを基板5上に流し込むことができ、薄膜の形成速度を速めることができる。

又、円筒形石英ガラス管13内に該ガラス管13の内壁に沿って線状ランプを適当な間隔をおいて配置しているので、上記ガラス管13の軸と直角な方向において基板5上の光の照度分布はある程度均一にできる。

（発明の効果）

以上のように、この発明に係る半導体製造装置によれば、複数の線状ランプを石英ガラス管内に組み込んだものを光源として用い、該光源を反応室内に設け、また上記石英ガラス管内に反射鏡兼用シャッタを設けたので、これによる反射光も加わり基板上の光の照度を高めて薄膜の形成速度を速めることができ、また薄膜形成完了後は、上記石英ガラス管13内にシャッタ10を設けたから、該シャッタ10による反射光が加わることによって上記照度をより一層高めることができる。このため光源12の出力を必要以上に高めることなく基板5上へ薄膜を非常に速く形成できる。

また、薄膜形成後はシャッタ10を下げることにより光源12からの光を遮蔽できるようにしたので、残留している反応ガスが分解してその反応生成物が上記石英ガラス管13表面に付着堆積するのを防止でき、線状ランプを点灯させたまま基板5を取り替えることができ、作業の効率化が図れる。

また、本実施例では反応ガス供給ノズル11とガス排出ノズル21を円筒形石英ガラス管13を挟んで該ガラス管13下方に設けたので、反応ガス4は、円筒形石英ガラス管13と基板5との間隔がもっとも狭く、基板5上の光の照度がもっとも強いところを流れ、該反応ガス4に光化学反応を速やかに起こさせることができる。またこれらノズル11，21を設けることにより、反応ガスシャッタを基板側に位置させて反応ガスへの光を遮蔽するようにしたので、余分な反応生成物が上記石英ガラス管に堆積するのを防止でき、これにより線状ランプを連続点灯したままで基板の取り替えができ、作業の効率化を図ることができる効果がある。

4．図面の簡単な説明

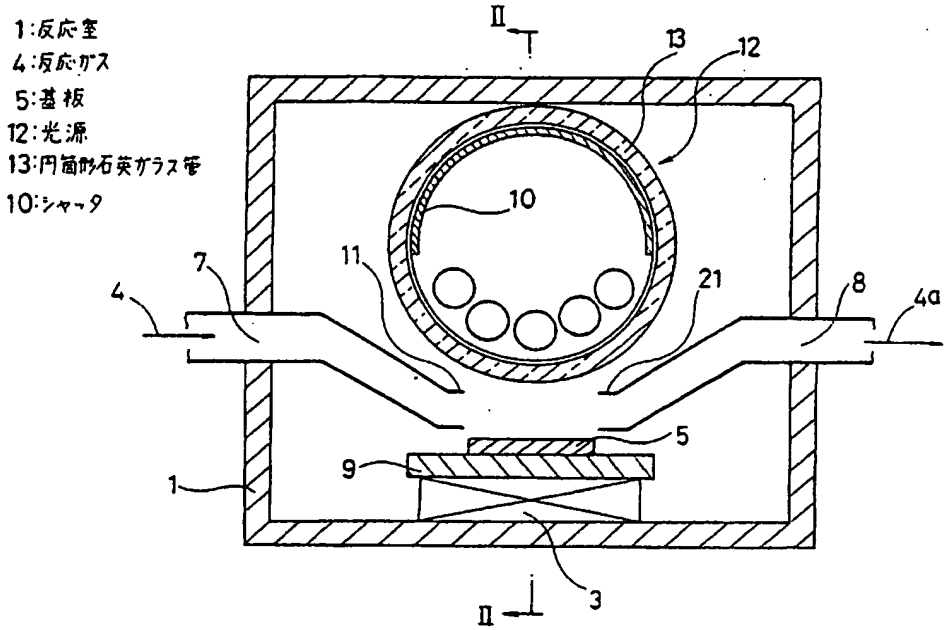
第1図は本発明の一実施例による半導体製造装置の断面側面図、第2図は第1図のII－II線断面図、第3図は従来の半導体製造装置の断面側面図である。

1…反応室、12…光源、4…反応ガス、5…基板、13…石英ガラス管、10…反射鏡兼用回転式シャッタ（反射遮蔽部材）。

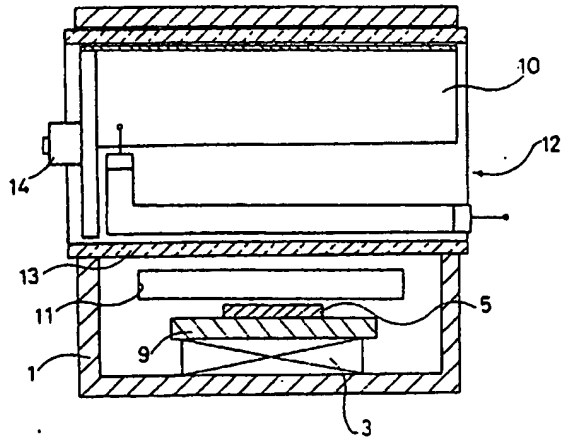
なお図中同一符号は同一又は相当部分を示す。

代理人　早瀬憲一

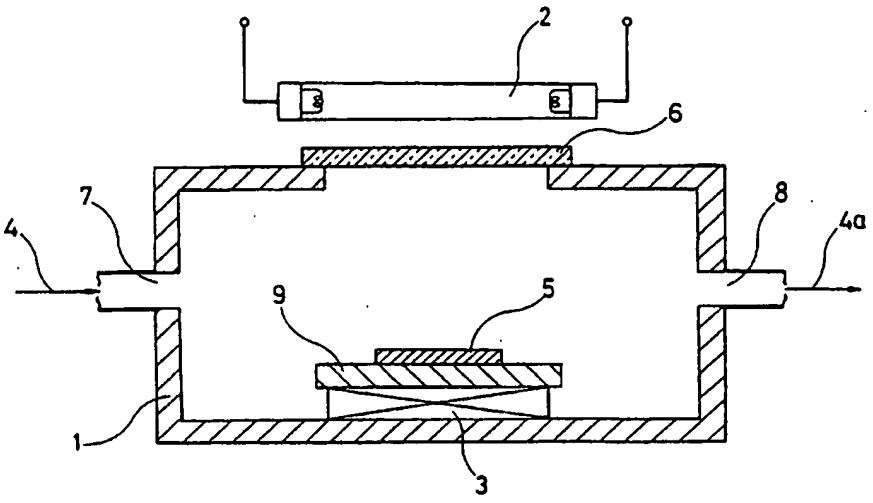
第 1 図



第 2 図



第３図



手　続　補　正　書（自発）

昭和 60 年 9 月 12 日

特許庁長官殿

1. 事件の表示　　特願昭　59－253455号

2. 発明の名称

半導体製造装置

3. 補正をする者

事件との関係　特許出願人
住　所　東京都千代田区丸の内二丁目２番３号
名　称　(601) 三菱電機株式会社
代表者　~~片山仁八郎~~
志岐守哉

4. 代　理　人　郵便番号 532
住　所　大阪市淀川区宮原４丁目１番45号
新大阪八千代ビル
氏　名　(8181) 弁理士　早瀬憲一
電話　06－391－4128

5. 補正の対象

明細書の発明の詳細な説明の欄

6. 補正の内容

(1) 明細書第９頁第８～１２行の「又、円筒形石英ガラス管１３内に……はある程度均一にできる。」を削除する。

以　上

特許庁

TRANSLATION

(19) Japanese Patent Office (JP)
(12) Japanese Patent Official Gazette (A)
(11) Unexamined Patent Publication (Kokai) No.: S61-131428
(43) Publication Date: June 19, 1986

(51) Int.Cl.[5]	ID	Interoffice File No.
H 01 L 21 / 205		7739-5F
21 / 263		
21 / 31		6708 – 5F

Examination required? No. No. of Claims: 1 Total of 5 pages

---

(54) Title of the Invention: Semiconductor Manufacturing Apparatus

(21) Patent Application No.: S59-253455

(22) Patent Filing Date: November 19, 1984

(72) Inventors:

Toshiyuki Kobayashi
Mitsubishi Electric Corporation
Manufacturing Engineering Center
Tsukaguchi - Honmachi, Amagasaki, Hyogo, Japan

Yoshinori Otomo
Mitsubishi Electric Corporation
Manufacturing Engineering Center
Tsukaguchi - Honmachi, Amagasaki, Hyogo, Japan

Yoshimi Kinoshita
Mitsubishi Electric Corporation
Manufacturing Engineering Center
Tsukaguchi - Honmachi, Amagasaki, Hyogo, Japan

Masao Oda
Mitsubishi Electric Corporation
Manufacturing Engineering Center
Tsukaguchi - Honmachi, Amagasaki, Hyogo, Japan

(71) Applicant:

Mitsubishi Electric Corporation
2-2-3 Marunouchi, Chiyoda-ku, Tokyo, Japan

(74) Agent:

Kenichi Hayase, Patent Attorney

SPECIFICATION

1. Title of the Invention:
Semiconductor Manufacturing apparatus

2. What is claimed is:
(1) A semiconductor manufacturing apparatus characterized by the fact that, in a semiconductor manufacturing apparatus in which light from a light source is projected into reaction gas inside a reaction chamber to give rise to a photochemical reaction to allow a thin film to form on a substrate placed in the said reaction gas, the above-mentioned light source comprises multiple linear lamps arranged in a quartz glass tube which is set up in the reaction chamber; and a reflection shield member (which is positioned on the non-substrate side to reflect the light to the reaction gas during the formation of the above-mentioned thin film, and is positioned on the substrate side to shield the light from the reaction gas when the above-mentioned thin film is not formed) is set up so as to be movable along the wall of the above-mentioned quartz glass tube.

3. Detailed Description of the Invention
[Field of Industrial Application]

The present invention relates to a semiconductor manufacturing apparatus in which a method to form a thin film on a substrate by decomposing the reaction gas photochemically (photochemical vapor decomposition: henceforth, called Photo Excitation CVD Method) is used to form a thin film.

[Related Art]

The CVD method is an important technology in forming thin film in the integrated circuits. In the conventional CVD method, mainly the reaction gas is heated to give rise to a chemical reaction. As a result, the reaction temperature rises to become a high temperature thereby causing a tendency to damage the thin film formed.

Consequently, in recent years the photo excitation CVD method receives attention as the low temperature CVD technology. In this photo excitation CVD method, light is used as the energy source. Compared to the conventional heat excitation CVD method or plasma CVD method, this method can lower the reaction temperature and minimize damaging to the thin film.

Moreover, it is known that in the photo excitation CVD method generally the intensity of light imparts a great influence on the rate of the thin film formation; it is also known that under the condition that the substrate temperature, reaction gas composition ratio and pressure are kept constant the rate of the thin film formation increases in proportion to the light irradiation strength.

Figure 3 illustrates a basic construction of the conventional thin film formation device according to such photo excitation CVD method as described above. In the drawing, 1 is the reaction chamber the inside of which is maintained in high vacuum during the film formation, 2 is the light source comprising linear lamps, 3 is the heater for heating the substrate, 4 is the reaction gas such as silane, 5 is the substrate on which a thin film is formed, 6 is the light incidence window composed of a light transmitting

material, 7 is the supply port of the reaction gas, 8 is the gas discharging port to discharge gas 4a after the reaction and 9 is the fixed stand on which substrate is placed.

Moreover, generally the pressure of the inside of reaction chamber 1 is reduced to maintain a state of high vacuum, and naturally the wall of reaction chamber 1 and light incidence window 6 composed of a light transmitting material are also constructed with a structure and sheet thickness that can endure this pressure.

In this device, when reaction gas 4 is introduced into reaction chamber 1 from reaction gas supply port 4, the said reaction gas 4 is subjected to excitation decomposition by the rays projected from incidence window 6. Then, the resultant reaction products are accumulated on substrate 5 heated at low temperature by heater 3 and a thin film is formed on the said substrate 5. Gas 4a after the reaction is discharged from discharging port 8.

[Problems to be Solved by the Invention]

In this conventional semiconductor manufacturing apparatus, as mentioned above, light incidence window 6 is set up in reaction chamber 1 and light is projected from light source 2 installed outside reaction chamber 1. In order to increase the rate of the thin film formation on substrate 5, the light illumination intensity on substrate 5 must be increased. Therefore, a light source of greater output must be used, or the distance between substrate 5 and light source 2 must be shortened and the illumination intensity on substrate 5 must be increased. However, at the present time, it is difficult to obtain a practical light source having long life and great output. Moreover, shortening the distance between substrate 5 and light source 2 while maintaining the conventional structure is also very difficult in view of the fact that light incidence window 6 composed of a light transmitting material must be installed between them in reaction chamber 1 with a structure that can endure the pressure of high vacuum.

Additionally, there is a problem that, when ultraviolet lamp 2 is lit, reaction products accumulate on the inner wall of reaction chamber 1 or light incidence window 6; there is also a problem that, when the thin film formation is completed on substrate 5, ultraviolet lamp 2 must be turned off, and if the lamp is turned on again it takes time before the irradiation strength stabilizes resulting in a poor operation efficiency.

The present invention is undertaken in order to eliminate these problems; it can enhance the light illumination intensity on the substrate. Furthermore, its objective is to obtain a semiconductor manufacturing apparatus that can improve operation efficiency.

[Means to Solve the Problems]

In the semiconductor manufacturing apparatus of the present invention, multiple linear lamps arranged in the quartz tube inside the reaction chamber are used as the light source, and a reflecting mirror and shutter in one which saves light or shields the light toward the substrate side is installed along the wall of the above-mentioned quartz glass tube so as to be movable.

[Operation]

In the present invention, since a light source comprising a quartz glass tube is set up inside a reaction chamber and a reflecting mirror and shutter in one is installed in the said quartz glass tube, the light illumination intensity on the substrate becomes very high and the thin film is formed rapidly. Moreover, since the light from the light source is shielded

by the shutter after the completion of the said formation, the substrate can be replaced as the linear lamps are lit, and the operation efficiency can be improved.

[Embodiments]

The working example is described with drawings in the following.

Figure 1 is a cross section of the semiconductor manufacturing apparatus in accordance with one working example of the present invention. Figure 2 shows the II – II line cross section of Figure 1. In both drawings, 1 is the reaction chamber, 13 is the cylindrical quartz glass tube installed inside the said reaction chamber 1, 12 is the light source in which multiple linear lamps are arranged along the inner wall of the said quartz glass tube 13, 10 is the reflecting mirror and rotary shutter in one installed along the inner wall of the above-mentioned quartz glass tube 13 so as to be movable; this is a reflecting-shielding member which is, during the thin film formation, positioned on the non-substrate side, namely, on the upper part of the above-mentioned inner wall to function as a reflecting mirror which reflects ultraviolet rays from linear lamps, and which is, when the film is not formed, positioned on the substrate side, namely on the bottom part to shield the light going toward the above-mentioned reaction gas 4. This member is (illegible) finished by polishing an aluminum plate. 14 is the shutter drive to drive the said shutter 10, 3 is the heater for heating the substrate, 4 is the reaction gas, 5 is the substrate, 7 is the supply port of the reaction gas, 8 is the gas discharging port for discharging gas 4a after the reaction, 9 is the stand on which substrate 5 is placed, 11 is the reaction gas supply nozzle set up in one end of the curved face side of cylindrical quartz glass tube 13, 21 is the gas discharging nozzle installed on the opposite side to the said nozzle 11 in such a way that cylindrical quartz glass tube 13 is sandwiched between the said supply nozzle 11 and 21.

The operation effect is described in the following.

In the present device, reaction gas 4 is fed from supply port 7 into reaction chamber 1. On the other hand, light is projected from cylindrical quartz glass tube 13, which is light source 12, the said reaction gas gives rise to a photochemical reaction and a thin film is formed on substrate 5 heated by heater 9. Moreover, at this juncture, shutter 10 inside the above-mentioned quartz glass tube 13 is positioned on the upper part.

Since, in the present device, multiple linear lamps arranged inside cylindrical quartz glass tube 13 are used as the light source and the said light source 12 is installed inside reaction chamber 1, the said light source 12 can be moved to any distance from substrate 5 to increase the light illumination intensity on substrate 5. What is more, since shutter 10 is installed inside quartz glass tube 13, the reflecting light from the said shutter 10 is added, thereby enabling the above-mentioned illumination intensity to increase more. Therefore, a thin film can be formed on substrate 5 at a very fast rate without increasing the output of light source 12 more than it needs.

Moreover, since light from light source 12 can be shielded by lowering shutter 10 after the thin film formation, the occurrence that the remaining reaction gas decomposes and the resultant reaction products deposit and accumulate on the surface of the above-mentioned quartz glass tube 13 can be prevented, substrate 5 can be replaced as the linear lamps are lit, and thus the operation efficiency can be improved.

Moreover, in the present working example, since reaction gas supply nozzle 11 and gas discharging nozzle 21 are installed under cylindrical quartz glass tube 13 so as to

allow the said glass tube 13 to be sandwiched between them, reaction gas 4 flows through a location where the space between cylindrical quartz glass tube 13 and substrate 5 is narrowest and the light illumination intensity on substrate 5 is strongest, and the said reaction gas 4 can undergo a photochemical reaction at a fast rate. Moreover, since reaction gas 4 needs to flow only a short distance due to the installation of these nozzles 12 and 21, a flow of reaction gas 4 to an unnecessary portion inside reaction chamber 1 can be prevented. Additionally, since the reaction gas can be allowed to flow a short distance efficiently, a uniform concentration and sufficient volume of the reaction gas can be allowed to flow on substrate 5 in accordance with the rate of the reaction gas photochemical reaction; thus the rate of thin film formation can be accelerated.

Moreover, since linear lamps are placed at proper intervals inside cylindrical quartz glass tube 13 along the inner wall of the said glass tube 13, the distribution of the light illumination intensity on substrate 5 in the direction perpendicular to the axis of the above-mentioned glass tube 13 can be made uniform to a certain degree.

[Advantageous Effects of the Invention]

As described above, in the semiconductor manufacturing apparatus of the present invention, multiple linear lamps placed in a quartz glass tube are used as the light source, the said light source is installed inside the reaction chamber and, additionally, a reflecting mirror and shutter in one is installed inside the above-mentioned quartz glass tube; as a result, together with the reflecting light from the reflecting mirror, the light illumination intensity on the substrate can be increased to accelerate the rate of the thin film formation. Moreover, after the completion of the thin film formation, since the above-mentioned shutter is positioned on the substrate side to shield the light going toward the reaction gas, an accumulation of excessive reaction products in the above-mentioned quartz glass tube can be prevented thereby enabling the substrate to be replaced as the linear lamps are lit continuously, and the operation efficiency can be improved.

4. Brief Description of the Drawings

Figure 1 illustrates a cross section side view of the semiconductor manufacturing apparatus in accordance with one working example of the present invention. Figure 2 is the II-II cross section of Figure 1, and Figure 3 is a cross section side view of a conventional semiconductor manufacturing apparatus.

[REFERENCE SYMBOLS]

1----- Reaction chamber
12--- Light source
4----- Reaction gas
5----- Substrate
13--- Quartz glass tube
10--- Reflecting mirror and rotary shutter in one
(Reflection shielding member)

Moreover, in the drawings, the same symbols indicate the same or equivalent parts.
Agent: Kenichi Hayase

DRAWINGS

FIGURE 1

1-----	Reaction chamber
4-----	Reaction gas
5-----	Substrate
12---	Light source
13---	Quartz glass tube
10---	Shutter

FIGURE 2

FIGURE 3

AMENDMENT (VOLUNTARY)

September 12, 1985

To: Commissioner of the Japanese Patent Office

1. Case No.: Japanese Patent Application No. S59-253455

2. Title of the Invention: Semiconductor Manufacturing apparatus

3. Amendment filed by:

   Relationship with the Case: Patent Applicant
   Name: (601) Mitsubishi Electric Corporation
   Representative: Moriyoshi Shiki
   Address: 2-2-3 Marunouchi, Chiyoda-ku, Tokyo, Japan

4. Agent:

   Name: (8181) Kenichi Hayase {seal}
   Address: Shin-Osaka Yachiyo Building
   4-1-45 Miyahara, Yodogawa-ku, Osaka, Osaka
   Phone: (06) 391-4128

{JPO Stamp}

5.Subject of Amendment

A column in the detailed description of the invention in this specification.

6.Gist of Amendment

(1) Delete page 9, LL 8-12 as follows:

[Moreover, since linear lamps are placed at proper intervals inside cylindrical quartz glass tube 13 along the inner wall of the said glass tube 13, the distribution of the light illumination intensity on substrate 5 in the direction perpendicular to the axis of the above-mentioned glass tube 13 can be made uniform to a certain degree.]

Translator's note: *The paragraph immediately before the advantageous effects of the invention is the paragraph should be deleted in accordance with this amendment.*